

CLAIMS

What is claimed is:

1 1. A method for searching an audio database for a target audio clip in a
2 multiprocessor system, comprising:
3 partitioning said audio database into a plurality of groups;
4 establishing a model for said target audio clip;
5 dynamically scheduling said plurality of groups to a plurality of processors
6 in said multiprocessor system; and
7 processing said scheduled groups in parallel by said plurality of
8 processors to search for said target audio clip.

1 2. The method of claim 1, wherein partitioning said audio database
2 comprises determining a size for each of said plurality of groups, said size being
3 determined to reduce the amount of overlapped computation among said
4 plurality of groups and load imbalance in parallel processing of said plurality of
5 groups.

1 3. The method of claim 1, wherein establishing a model for said target
2 audio clip comprises extracting a feature vector sequence from said target audio
3 clip and modeling said feature vector sequence based on a Gaussian Mixture
4 model ("GMM"), said GMM including a plurality of Gaussian components.

1 4. The method of claim 3, wherein modeling said feature vector sequence
2 comprises estimating mixture weights for each of said plurality of Gaussian
3 components.

1 5. The method of claim 1, wherein processing said scheduled groups in
2 parallel comprises:
3 partitioning each of said scheduled groups into at least one segment; and
4 for each segment,
5 extracting a feature vector sequence for the segment, and
6 modeling said feature vector sequence based on a Gaussian
7 Mixture model ("GMM"), said GMM including a plurality of Gaussian
8 components.

1 6. The method of claim 5, wherein each of said at least one segment has
2 the same length in time as that of said target audio clip.

1 7. The method of claim 5, wherein if there are more than one segments in
2 an audio stream, each segment partially overlaps with a segment that
3 immediately precedes that segment.

1 8. The method of claim 5, wherein said plurality of Gaussian components
2 are common for different segments and said target audio clip.

1 9. The method of claim 8, wherein modeling said feature vector sequence
2 comprises estimating mixture weights for each of said plurality of Gaussian
3 components.

1 10. The method of claim 9, further comprising: for each segment,
2 computing a Kullback-Leibler ("KL") distance between a GMM of said
3 segment and a GMM of said target audio clip; and
4 determining that said segment matches said target audio clip, if said KL
5 distance is smaller than a pre-determined threshold.

1 11. The method of claim 10, further comprising skipping processing a
2 number of segments if said KL distance is larger than a predetermined value,
3 said number of segments dependent on the value of said KL distance.

1 12. The method of claim 1, wherein said multiprocessor system
2 comprises a memory shared by said plurality of processors.

1 13. An apparatus for searching an audio database for a target audio clip
2 in a multiprocessor system, comprising:
3 a partitioning module to partition said audio database into a plurality of
4 groups;
5 a scheduler to dynamically schedule said plurality of groups to a plurality
6 of processors in said multiprocessor system; and

7 an audio searching module for each of said plurality of processors to
8 process said scheduled groups in parallel by said plurality of processors to
9 search for said target audio clip.

1 14. The apparatus of claim 13, wherein said partitioning module further
2 determines a size for each of said plurality of groups, said size being determined
3 to reduce the amount of overlapped computation among said plurality of groups
4 and load imbalance in parallel processing of said plurality of groups.

1 15. The apparatus of claim 13, wherein an audio searching module
2 comprises:
3 a feature extractor to partition an input audio stream into at least one
4 segment and to extract a feature vector sequence from each of said at least one
5 segment, said at least one segment having the same length in time as that of
6 said target audio clip; and
7 a modeling module to model said feature vector sequence for each
8 segment based on a Gaussian Mixture model ("GMM"), said GMM including a
9 plurality of Gaussian components, said plurality of Gaussian components being
10 common among all of the segments.

1 16. The apparatus of claim 15, wherein one of audio searching modules
2 further process said target audio clip by extracting a feature vector sequence
3 from said target audio clip and by modeling said feature vector sequence using

4 said GMM, said GMM including a plurality of Gaussian components common for
5 said target audio clip and segments of said input audio stream.

1 17. The apparatus of claim 16, wherein an audio searching module
2 further comprising a decision maker to compute a Kullback-Leibler ("KL")
3 distance between a GMM of a segment of said input audio stream and a GMM of
4 said target audio clip; and to determine whether said segment matches said
5 target audio clip based on said KL distance.

1 18. The apparatus of claim 17, wherein said decision module further
2 determines how many segments are to be skipped from processing based on
3 said KL distance.

1 19. An article comprising a machine-readable medium that contains
2 instructions, which when executed by a processing platform, cause said
3 processing platform to perform operations comprising:
4 partitioning said audio database into a plurality of groups;
5 establishing a model for said target audio clip;
6 dynamically scheduling said plurality of groups to a plurality of processors
7 in said multiprocessor system; and
8 processing said scheduled groups in parallel by said plurality of
9 processors to search for said target audio clip.

1 20. The article of claim 19, wherein partitioning said audio database
2 comprises determining a size for each of said plurality of groups, said size being
3 determined to reduce the amount of overlapped computation among said
4 plurality of groups and load imbalance in parallel processing of said plurality of
5 groups.

1 21. The article of claim 19, wherein establishing a model for said target
2 audio clip comprises extracting a feature vector sequence from said target audio
3 clip and modeling said feature vector sequence based on a Gaussian Mixture
4 model ("GMM"), said GMM including a plurality of Gaussian components.

1 22. The article of claim 21, wherein modeling said feature vector
2 sequence comprises estimating mixture weights for each of said plurality of
3 Gaussian components.

1 23. The article of claim 19, wherein processing said scheduled groups in
2 parallel comprises:
3 partitioning each of said scheduled groups into at least one segment; and
4 for each segment,
5 extracting a feature vector sequence for the segment, and
6 modeling said feature vector sequence based on a Gaussian
7 Mixture model ("GMM"), said GMM including a plurality of Gaussian
8 components.

1 24. The article of claim 22, wherein each of said at least one segment
2 has the same length in time as that of said target audio clip.

1 25. The article of claim 22, wherein if there are more than one segments
2 in an audio stream, each segment partially overlaps with a segment that
3 immediately precedes that segment.

1 26. The article of claim 22, wherein said plurality of Gaussian components
2 are common for different segments and said target audio clip.

1 27. The article of claim 26, wherein modeling said feature vector
2 sequence comprises estimating mixture weights for each of said plurality of
3 Gaussian components.

1 28. The article of claim 27, wherein said operations further comprise: for
2 each segment,
3 computing a Kullback-Leibler ("KL") distance between a GMM of said
4 segment and a GMM of said target audio clip; and
5 determining that said segment matches said target audio clip, if said KL
6 distance is smaller than a pre-determined threshold.

1 29. The article of claim 28, wherein said operations further comprise
2 skipping processing a number of segments if said KL distance is larger than a
3 predetermined value, said number of segments dependent on the value of said
4 KL distance.

1 30. The article of claim 19, wherein said multiprocessor system
2 comprises a memory shared by said plurality of processors.